

INCREMENTAL COST PRINCIPLES FOR LOCAL AND WIRELESS NETWORK INTERCONNECTION

Timothy J. Tardiff and Richard D. Emmerson

I. INTRODUCTION

In its Notice of Proposed Rulemaking, the Federal Communications Commission correctly recognized that long run incremental cost (LRIC) is the correct starting point for establishing prices for telecommunications services, including local interconnection.¹ Basing price floors on incremental costs, among other benefits, is consistent with the fundamental economic principle of cost causation—price should reflect the costs imposed on society when resources are consumed. In this regard, the Notice seeks comments on the use of flat rate pricing for dedicated facilities and time-of-day pricing for shared facilities.²

The purpose of this paper is to describe the economic principles that should be followed in calculating incremental costs for interconnection pricing purposes. Our discussion builds on our participation in the cost investigations that are currently underway in California to establish costs and prices for unbundled network elements and to determine the size of the universal service funding requirements for California's local exchange providers. While the purposes of the California efforts and the details of the particular studies may differ somewhat from what is required to establish local interconnection prices, the fundamental principles are the same. An additional objective of the paper is to address the FCC's specific interest in flat rate pricing for dedicated facilities and time-of-day pricing for shared facilities.

¹ Interconnection Between Local Exchange Carriers and Commercial Mobile Radio Service Providers, CC Docket No. 95-185, Equal Access and Interconnection Pertaining to Commercial Mobile Radio Service Providers, CC Docket No. 94-54, *Notice of Proposed Rulemaking*, January 11, 1996, p. 24 ("Notice")

² Notice, p. 22.

The remainder of the paper is organized as follows. First, we enumerate the economic principles that guide the determination of incremental costs and the prices that follow from these costs. Second, we apply these principles to the specific rate design issues raised in the Notice. Third, the final section summarizes the paper.

II. ECONOMIC PRINCIPLES

The regulatory purpose of measuring incremental costs is to establish prices and pricing safeguards so that competitive outcomes emulate the working of markets where price regulation is unnecessary. The intended outcome is simple: in the long run, a competitive firm does not lose money when offering its products and services. The procompetitive price floor becomes the relevant incremental cost.

Professor Kahn's text on regulatory economics, originally written over 20 years ago, anticipated many of the cost issues that are germane to this proceeding.³ Kahn's analysis started from the basic premise that prices at short-run marginal cost are optimal under static conditions. In order to extend the inquiry into dynamic conditions, *e.g.*, demand patterns varying over time, competition growing and changing, etc., he concluded that, for practical purposes and in competitive situations, long run marginal cost was the appropriate standard:

...society's interest is in having...communications provided at the lowest possible cost, with due allowance for possible differences in the quality of services supplied or the costs imposed on the users. And economic efficiency requires, additionally, that no business be turned away that covers the cost to society of providing that service. These basic goals are served by permitting rates to be set at long-run marginal costs. The consequence will be that, after consumers have made allowance in their choices for possible differences in the quality of the service, the competing company with the lowest long-run marginal cost will get the business; and the services will thus be provided by those companies which, in so doing, will impose the minimum opportunity costs on the economy at large.⁴

³ Alfred E. Kahn, *The Economics of Regulation*, Cambridge: The MIT Press, 1988. Originally published in 1970-71 (Kahn).

⁴Kahn, Vol. I, pp. 160-161.

Incremental cost is the additional cost a firm incurs (or avoids) in providing (or discontinuing) a service (or some increment of that service).⁵ The correct measure of incremental cost depends on the specific business decision at issue. For example, if the issue is whether revenues from an entire service exceed cost, the relevant volume is the entire service. Alternatively, a particular pricing decision may affect only a subset of the entire service's volume and it is that volume that defines the correct incremental cost (including service-specific fixed costs).

Several issues and principles need to be considered in establishing costs. First, in focusing on additional costs, the perspective is forward looking, with explicit recognition of cost-causation. Users of a service are responsible for the costs imposed by using the service, but only for those costs.⁶ Costs excluded by this principle include any assigned through arbitrary allocations, such as through uniform assignment of fixed costs to usage services or assignment of sunk costs to any service.

The costs caused by offering a service (or an increment of demand for that service) can be volume-sensitive, service-specific fixed costs, and/or shared costs. The presence of non volume-sensitive costs in telecommunications gives rise to scale and scope economies, which, in turn, imply that pricing all services at incremental cost will not recover the total forward-looking cost of the business.

In addition, practical cost analysis must consider the size of the increment and the time horizon of the decision. Kahn previously discussed these issues as follows:

...long-run incremental cost (which we shall loosely refer to as long-run marginal cost as well) would be based upon (1) the average incremental variable costs of those added sales and (2) estimated additional capital costs per unit, for the additional capacity that will have to be constructed if sales at that price are expected to continue over time or to grow. Both of these components would be estimated as averages over some period of years extending into the future.⁷

⁵A formal definition of incremental cost is given by the following equation.

$LRIC_i = C(V_1^0, V_2^0, \dots, V_i^1, \dots, V_k^0) - C(V_1^0, V_2^0, \dots, V_i^0, \dots, V_k^0)$ In words, the cost for a service is the difference in the company's total cost at two different levels of output. If $V_i^0 = 0$ and $V_i^1 =$ current output, the equation defines total-service long-run incremental cost (TSLRIC).

⁶Kahn, Vol. I, p. 71.

⁷Kahn, Vol. I, p. 85.

The relevant increment is clearly related to a particular business decision: of course, the proper size of the incremental unit of output depends on the perspective of the decision under consideration.⁸ Indeed, basing costs on the wrong increment (*e.g.*, all toll volumes instead of the toll services purchased by the users affected by a pricing action) would violate cost-causation in that costs not caused by those users would be assigned to them anyway. For example, if the cost of billing were lower for a particular group of toll users, assigning an average billing cost would overstate the cost of providing toll to that group.

The correct incremental cost definition is also based upon the firm's own cost structure and how that structure is changed by real business decisions. It is not based upon the cost structure of some hypothetical firm. As Kahn noted, in the context of competitive pricing: The marginal costs against which competitive rates should be judged are the costs of the company quoting or proposing to quote those rates, *not the costs of their competitors*.⁹

Finally, because local exchange carriers (LECs) are multiproduct firms, their costs depend on the outputs of all products. Because of the existence of economies of scope (fixed costs that are shared by two or more services), the prices of the services that share the fixed costs must exceed incremental cost in order to recover all costs. That is, unlike perfect competition, where prices are driven to cost, telecommunications markets, like most other markets, are imperfectly competitive. Therefore, prices must generally depart from incremental costs, with demand conditions being the primary determinant of the price-cost margin. In particular, interstate access and interconnection rates must be above incremental cost in order to provide LECs with the opportunity to recover all costs. To the extent that access charge and universal service reform shift the recovery of some of these costs to non-traffic sensitive services and/or to a surcharge on the revenues of all providers, rates for particular interconnection elements may be reduced towards incremental cost.

⁸Kahn, Vol. I, p. 76.

⁹Kahn, Vol. I, p. 164, emphasis in the original.

To summarize, with imperfect competition, incremental cost defines the *minimum* price level. Prices themselves will typically be above the minimum, with more price elastic services being closer to the minimum than services that are less elastic. A regulatory regime designed to emulate this competitive outcome would use incremental costs to establish *price floors*, not set prices. LECs would then be free to price at or above these floors depending on the market conditions they faced.

III. RATE STRUCTURE IMPLICATIONS

The Notice (pages 22-23) distinguished between three types of costs—dedicated, peak-sensitive shared costs, and other shared costs—and recommends rate structures for each. For the most part, the FCC’s economic reasoning here is sound and is consistent with the costing principles discussed above.¹⁰

For dedicated facilities, the cost-causing event is a customer ordering additional dedicated facilities. Once those facilities are ordered, no additional cost is incurred in using them. The incremental cost is usage-insensitive and price should be structured accordingly. The FCC seems to imply that the flat charge should be equal to costs. As we described above, to the extent that there are joint and/or common costs that need to be recovered, mark-ups over incremental costs that reflect demand conditions are necessary. In principle, dedicated facilities could be marked up in this manner.¹¹

The Notice also discusses the cost of shared facilities whose costs vary with capacity.¹² The discussion correctly notes that these capacity costs, are for the most part, associated with peak usage. Practical problems arise in identifying peak period costs, including the fact that the

¹⁰ In this regard, we note that the tentative adoption of “bill and keep” for usage-sensitive costs is generally inconsistent with the principle of cost-causation that the FCC correctly applies in its discussion of pricing principles.

¹¹ Not allowing mark-ups on dedicated facilities could also distort economic efficiency if customers were uneconomically diverted from switched (shared) facilities because of mark-ups on the latter. In fact, it was this very distortion that motivated the FCC’s shift from carrier to end-user charges for switched access.

¹² Although such costs are shared in the sense that the same facility serves different customers (or different products), these costs increase or decrease with usage of specific services. Therefore, they are volume-sensitive costs associated with those services.

peak hour varies by location across an LEC's network and the fact that establishing a peak/off peak differential may cause the peak to shift in response to that differential. In practice, our cost studies have dealt with peak period costs by identifying the time period over which particular offices are likely to peak and then probabilistically assigning costs, based on the proportion of peak capacity occurring in a particular hour. This approach produces fairly long daily peaks, which would generally be insensitive to the problem of peak shifting in response to peak/off-peak price differentials. For *pricing* purposes, capacity costs may be reported by billing period, e.g., the peak period of 7:00a.m. to 8:00p.m. period that is common for cellular usage charges. Finally, to the extent that the establishment of peak/off-peak pricing differentials imposes additional costs, e.g., metering and billing costs, those costs should be weighed against the efficiency gains the differential is designed to provide.

Finally, the Notice identifies shared costs that are not volume-sensitive. The Notice seems to limit recovery of such costs to mark-ups on peak (and perhaps off-peak) rate elements. As we discussed earlier, costs that are not volume-sensitive should be recovered by mark-ups (potentially on *all* services) that reflect the demand for these services which share these costs. In particular, to the extent that dedicated facilities share these costs with usage based services, mark-ups over incremental cost on the dedicated services may be economically efficient.

In addition, we note that there may be other costs that do not fall in the three categories identified in the Notice. For example, the costs associated with a billing inquiry for a particular call are volume-sensitive costs that are neither dedicated or peak-related. Such costs should be assigned on the principle of cost-causation, i.e., to the increase in volume that caused the cost to be incurred.

IV. CONCLUSIONS

In its Notice, the Commission has correctly recognized the central role that proper incremental cost standards play in establishing efficient interconnection prices. In terms of the rate structures for which the Commission seeks comments, we offer the following conclusions.

- Prices should be set consistent with the fundamental principle of cost causation.
- Flat rate pricing for facilities dedicated to specific users is generally sound.

- Practical time-of-day pricing for facilities that are shared by users and/or services and for which peak period use determines capacity is consistent with the principle of cost causation, to the extent that any additional costs caused by peak period pricing are less than the efficiency gains. To avoid the problem of the peak period shifting in response to the price differential, the peak periods of long duration should be used.
- The Notice identifies other shared costs that are not volume-sensitive. Economic efficiency implies that these costs be recovered in the form of mark-ups over the prices for volume-sensitive services, with demand conditions determining the sizes of the mark-ups. That is, because of the prevalence of costs that do not vary with output, telecommunications prices must generally be greater than incremental cost in order to recover these volume-sensitive costs.

EXHIBIT E

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C18-A. WIRELESS INTERCONNECTION SERVICE

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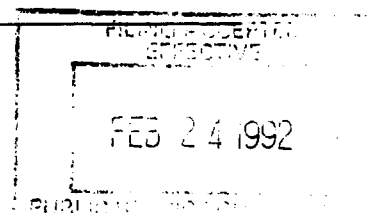
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C18-A. WIRELESS INTERCONNECTION SERVICE

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18-A. WIRELESS INTERCONNECTION SERVICE

18.1 GENERAL

Wireless Interconnection Service is available to Cellular Mobile Carriers (CMC) for use in furnishing their services to End Users. Wireless Interconnection Service may not be used as a substitute for the Utility's local and/or general exchange and/or access services. Wireless Interconnection Service provides for the ability to complete mobile-to-land calls from the CMC Point of Termination (POT) and terminate land-to-mobile calls at the CMC POT. Specific references to material describing elements of Wireless Interconnection Service are provided in P.S.C.N. C18.2.3.

Rates and charges for Wireless Interconnection Service are set forth in C18.7.1 following. The application of rates for Wireless Interconnection Service is described in C18.6.1 following. Rates and charges for services other than Wireless Interconnection Service, e.g., a customer's toll message service, may also be applicable when Wireless Interconnection Service is used in conjunction with these other services. Descriptions of such applicability are provided in C18.1.2 following.

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C18-A. WIRELESS INTERCONNECTION SERVICE

18.1 GENERAL (Cont'd)

18.1.1 WIRELESS INTERCONNECTION SERVICE ARRANGEMENTS AND MANNER OF PROVISION

Wireless Interconnection Service is provided in several different serving arrangements. These are differentiated by their technical characteristics, e.g., line side vs. trunk side connection, and available from Utility end office or from the access tandem. A brief description of each wireless interconnection arrangement is in C18.2 following. Ordering conditions in the provision of Wireless Interconnection Service are set forth in C5.1.1 preceding.

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C18-A. WIRELESS INTERCONNECTION SERVICE

18.1 GENERAL (Cont'd)

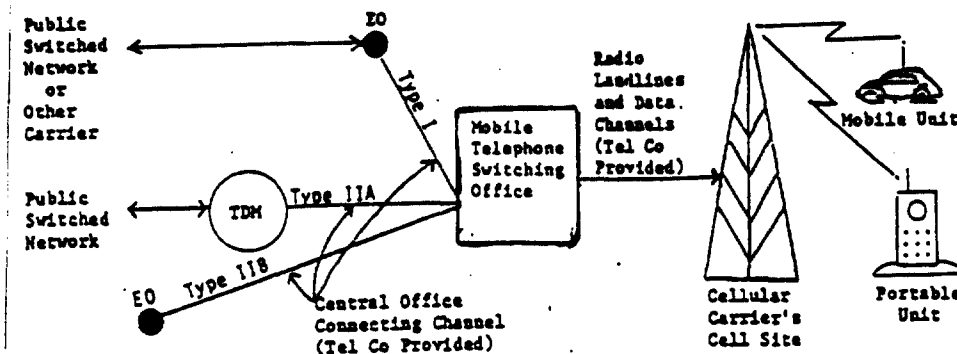
18.1.1 WIRELESS INTERCONNECTION SERVICE ARRANGEMENTS AND MANNER OF PROVISION (Cont'd)

Type 2A and 2B Wireless Interconnection Service are trunk side connections while Type 1 may be a line or trunk side connection. The trunk side signalling may be FGD and is more fully described under Technical Specifications. The line side connection may be loop start or ground start. Technical limitations may dictate separate trunk groups for different traffic types. Ordering conditions in the provision of Wireless Interconnection Service are set forth in C5 preceding.

Wireless Tandem Transport is also available to CMCs for use in terminating local dialed calls on Type 2A Wireless Interconnection trunks.

Type 1 and 2B Wireless Interconnection trunks are available from Utility end offices; Type 1 (without 911 traffic) and Type 2A Wireless Interconnection trunks are available from the access tandem at rates set forth in the following section. When Type 2A Wireless Interconnection Service is selected it must be used for all non-ancillary access. CMCs may not mix measured and flat rate service for Wireless Interconnection.

The following diagram depicts a generic configuration of a cellular system and the interconnecting facilities.



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C18-A. WIRELESS INTERCONNECTION SERVICE

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18.1 GENERAL (Cont'd)

18.1.2 RATE CATEGORIES

A. DESCRIPTION

1. Wireless interconnection is a two-way voice frequency transmission path composed of facilities determined by the Utility.
2. The Utility will work cooperatively with the customer in determining (1) whether the service is to be directly routed to an end office switch or through an access tandem switch, and (2) the directionality of the service.
3. Wireless Interconnection Service is provided at rates and charges set forth in C18.7.1 following. The usage sensitive rates are applied on a per minute of use basis.

B. APPLICATION

1. Type 1 trunks may be flat rate or measured service. The rates for Type 1 trunks are identical to PBX trunks plus applicable charge for the interconnecting facility. CMCs are also charged for applicable exchange tariff usage. The PBX trunk terminations are described in Section A5.3 preceding.
2. Type 2A trunks have a recurring MOU based charge applied to mobile-to-land traffic. Directory Assistance Service Rates (described in C9-A) are also applicable to calls terminated at a Directory Assistance Service location on Type 2A trunks.
 - a. Wireless Interconnection Rate applies to all mobile-to-land usage. It is applicable to conversation time only and is a derived average rate applicable to metropolitan and rural serving area CMCs alike.
3. Type 2B trunks are only available as flat rate trunks. The rates for Type 2B trunks are identical to PBX trunks plus applicable charge for the interconnecting facility. CMCs are also charged for applicable exchange tariff usage. The PBX trunk terminations are described in Section A5.3 preceding.

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ACCESS SERVICE

C18-A. WIRELESS INTERCONNECTION SERVICE

18.1 GENERAL (Cont'd)

18.1.3 SPECIAL FACILITIES ROUTING

Any customer may request that the facilities used to provide Wireless Interconnection Service be specially routed. The regulations, rates and charges for Special Facilities Routing (i.e., Avoidance, diversity and Cable-only) are set forth in C11. preceding.

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C18-A. WIRELESS INTERCONNECTION SERVICE

18.1 GENERAL (Cont'd)

18.1.4 DESIGN LAYOUT REPORT

At the request of the customer, the Utility will provide to the customer the makeup of the facilities and services provided from the customer's premises to the first point of switching. This information will be provided in the form of a Design Layout Report. The Design Layout Report will be provided to the customer at no charge, and will be reissued or updated whenever these facilities are materially changed.

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C18-A. WIRELESS INTERCONNECTION SERVICE

18.1 GENERAL (Cont'd)

18.1.5 TESTING

The Utility will provide Acceptance Testing and Routine Testing in accordance with Switched Access Testing described in Section C6.1.6 preceding. Access to 100, 102, 105 and 107 type test lines will be provided subject to network considerations. Additional Automatic Testing, and Additional Manual Testing are available as set forth in C13.3.5 preceding.

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C18-A. WIRELESS INTERCONNECTION SERVICE

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8.2 PROVISION AND DESCRIPTION OF WIRELESS INTERCONNECTION SERVICE

Wireless Interconnection Service is provided in three different arrangements.

18.2.1 MANNER OF PROVISION

Wireless Interconnection Service is ordered under the Access Order provision set forth in C5.2 preceding. Also, included in that section are other charges which may be associated with ordering Wireless Interconnection Service (e.g., Service Date Change Charges, Cancellation Charges, etc.)

Type 2A Wireless Interconnection Service is provided the same as the FGD Switched Access arrangements. Type 2A Wireless Interconnection Service is only available from the access tandem. Type 1 Wireless Interconnection Service (without 911 Traffic) is available from the access tandem. The Type 1 and 2B interconnection is available from end offices and provided the same as PBX arrangements. All Wireless Interconnection trunks may be arranged for either originating, terminating, or two-way calling depending on network limitations. The Utility will work cooperatively with the customer to determine trunk and number requirements.

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C18-A. WIRELESS INTERCONNECTION SERVICE

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18.2 PROVISION AND DESCRIPTION OF WIRELESS INTERCONNECTION SERVICE (Cont'd)

18.2.2 TRAFFIC TYPES

Wireless Interconnection Service is provided in several different serving arrangements and may require joint engineering. The categories of CMC traffic are as follows:

- IntraLATA mobile-to-land
 - Includes service codes 611 and 811
 - 911 is not available at the access tandem
- InterLATA mobile-to-land
- InterLATA and IntraLATA land-to-mobile
- Nevada Bell operator assistance mobile-to-land
 - Includes IEC operator handoff to IECs with Operator Services Signaling (OSS) trunking
- InterLATA operator assistance mobile-to-land
- Directory assistance mobile-to-land
- 800 service access codes mobile-to-land
- 900 service access codes mobile-to-land

Because some customers will not require all traffic types or because segregation may be required by network considerations some of these traffic types may be combined on the same trunk group.

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C18-A. WIRELESS INTERCONNECTION SERVICE

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18.2 PROVISION AND DESCRIPTION OF WIRELESS INTERCONNECTION SERVICE (Cont'd)

18.2.3 DESCRIPTIONS

A. Type 1 Trunk

The Type 1 trunk is a dedicated one-way trunk between the Utility end office and the CMC's POT. Type 1 "subscriber line treatment" allows incoming calls from the CMC to be connected to any valid office code(s) as well as Repair Service, Directory Assistance, Operator Assistance or services provided by interexchange carriers, other CMCs or Local Exchange Carriers. Calls from the public switched network to the CMC are connected through the end office associated with the called cellular mobile station number.

B. Type 2A Trunk

The Type 2A Trunk is a dedicated two-way trunk between the Utility tandem office and the CMC's POT. Incoming calls from the CMC are connected to any valid office code(s) within the LATA. Calls from the public switched network are connected to the CMC through the tandem office associated with the called cellular mobile station number.

C. Type 2B Trunk

The Type 2B Trunk is a dedicated one-way or two-way trunk with (DID) option between the Utility end office and the CMC's POT. Incoming calls from the CMC are connected only to those valid subscriber telephone numbers served by the Utility end office. Calls from the Utility end office are connected to the Cellular Carrier.

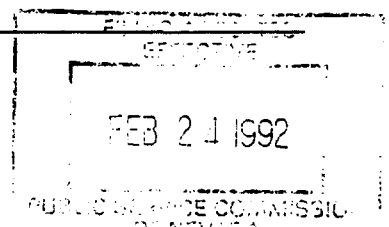
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C18-A. WIRELESS INTERCONNECTION SERVICE

18.2 PROVISION AND DESCRIPTION OF WIRELESS INTERCONNECTION SERVICE (Cont'd)

18.2.4 OPTIONAL FEATURES

1. Bill Number Screening
2. Alternate Traffic Routing

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C18-A. WIRELESS INTERCONNECTION SERVICE

18.2 PROVISION AND DESCRIPTION OF WIRELESS INTERCONNECTION SERVICE (Cont'd)

18.2.5 TRANSMISSION SPECIFICATIONS

Wireless Interconnection Service is provided with standard transmission path specifications. Switched Access transmission specifications described in section C6.4 preceding also apply to Type 2A Wireless Interconnection Service.

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Nevada Bell
645 E. Plumb Lane, Reno, Nevada
Tariff P.S.C.N. No. C18-A

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ACCESS SERVICE

C18-A. WIRELESS INTERCONNECTION SERVICE

18.3 TECHNICAL SPECIFICATIONS

The design, installation, operation and maintenance of all circuits, equipment, and other facilities used in providing Wireless Interconnection Service shall be made in accordance with the following technical specifications, including but not limited to: Technical Reference TR-NPL-000145, Technical Reference TR-EOP-000352, Technical Reference TR-NPL-000334 and Special Report SR-TSV-002275. These specifications are available through Bell Communications Research (BELLCORE), 60 New England Avenue, Piscataway, NJ 08854 as set forth in C1.1.4 preceding.

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ACCESS SERVICE

C18-A. WIRELESS INTERCONNECTION SERVICE

(N)

18.4 OBLIGATIONS OF THE UTILITY

In addition to the obligations of the Utility set forth in C2-A preceding, the Utility has certain other obligations pertaining only to the provisioning of Type 2A Wireless Interconnection Service. These obligations are as follows:

18.4.1 NETWORK MANAGEMENT

The Utility will administer its network to insure the provision of acceptable service levels of all telecommunications users of the Utility's network services. Generally, service levels are considered acceptable only when both End Users and customers are able to establish connections with little or no delay encountered within the Utility network. The Utility maintains the right to apply protective controls, i.e., those actions, such as call gapping, which selectively cancel the completion of traffic over any traffic carried over its network, including that associated with a customer's Wireless Interconnection Service. Generally, such protective measures would only be taken as a result of occurrences such as failure or overload of Utility or customer facilities, natural disasters, mass calling, or national security demands. In the event that the protective controls applied by the Utility result in the complete loss of service by the customer, the customer will be granted a Credit Allowance for Service Interruption as set forth in C2.4.4 preceding.

18.4.2 DESIGN AND ROUTING OF WIRELESS INTERCONNECTION SERVICE

The Utility will work cooperatively with the customer in determining acceptable network configuration between customer POT and Utility access tandem or end office.

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C18-A. WIRELESS INTERCONNECTION SERVICE

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18.4 OBLIGATIONS OF THE UTILITY (Cont'd)

18.4.3 PROVISION OF SERVICE PERFORMANCE DATA

Subject to availability, end-to-end service performance data available to the Utility through its own service evaluation routing, may also be made available to the customer based on previously arranged intervals and format. These data provide information on overall end-to-end call completion and non-completion performance, e.g., customer equipment blockage, failure results and transmission performance. These data do not include service performance data which are provided under other tariff sections, e.g. testing service results. If data are to be provided in other than paper format, the charges for such exchange will be determined on an individual case basis.

18.4.4 TRUNK GROUP USAGE REPORTS

Subject to availability, the Utility will make available trunk group data in the form of usage in CCS, peg count and overflow, to the customer, based on previously agreed to intervals.

The Utility will perform routine measurement functions to assure that an adequate number of transmission paths are in service. The utility will recommend that additional capacity (i.e., trunks) be ordered by the customer when additional paths are required to reduce the measured to the designed blocking level. For the capacity ordered, the design blocking objective is assumed to have been met if the routine measurements show that the measured blocking does not exceed the threshold listed in the tables in C6.5.7E preceding.

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